GAPS WHERE RESEARCH MIGHT HELP TO ANSWER QUESTIONS (FROM INDUSTRY POINT OF VIEW)

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NZ Centre for Earthquake Resilience
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TOPIC 1: Interaction of Different Types of Lateral Resisting Systems in a Structure

Reality from Experimental Tests

vs

Analytical Model

Topic 1: Interaction of Different Lateral Resisting Systems

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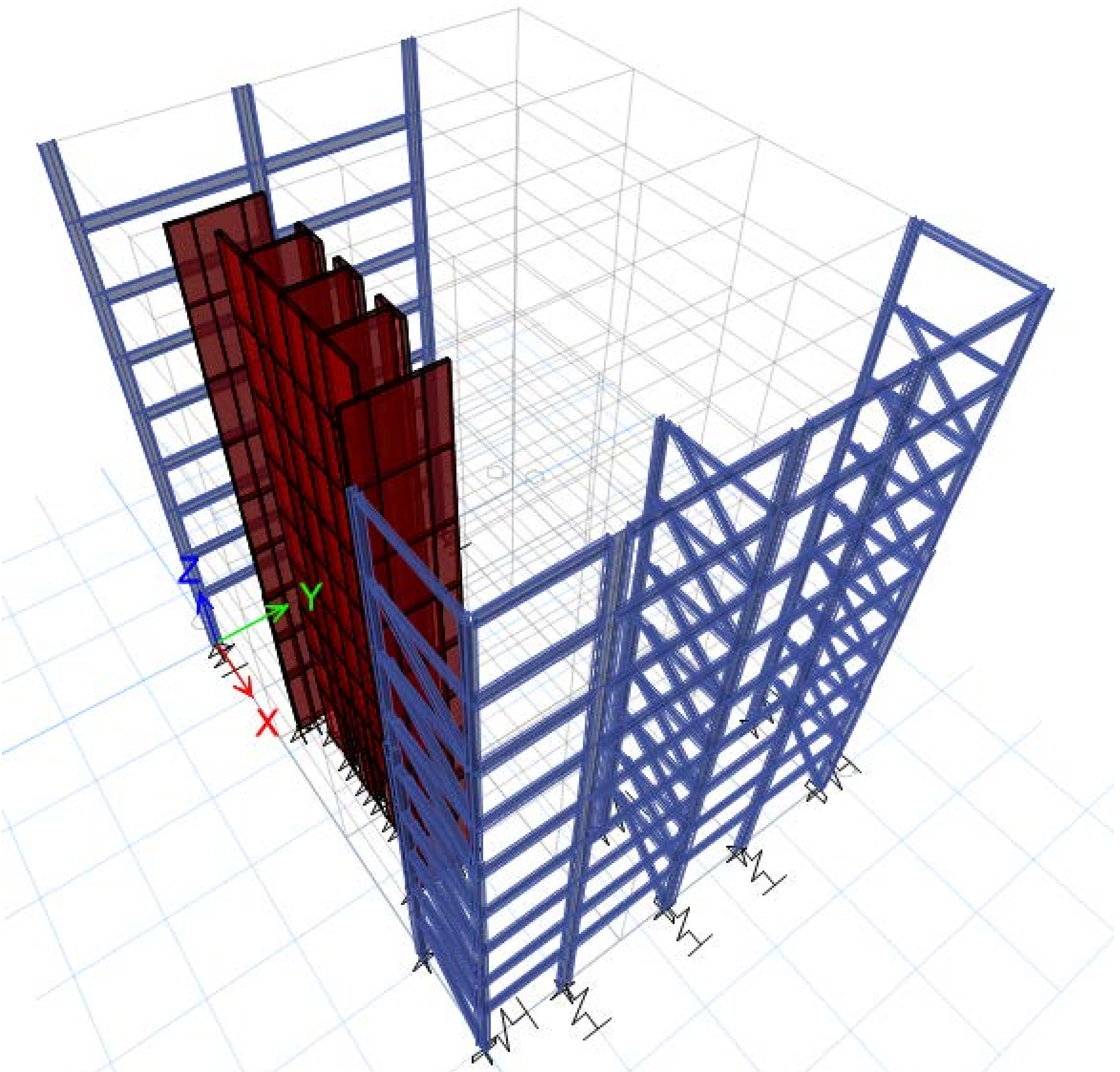
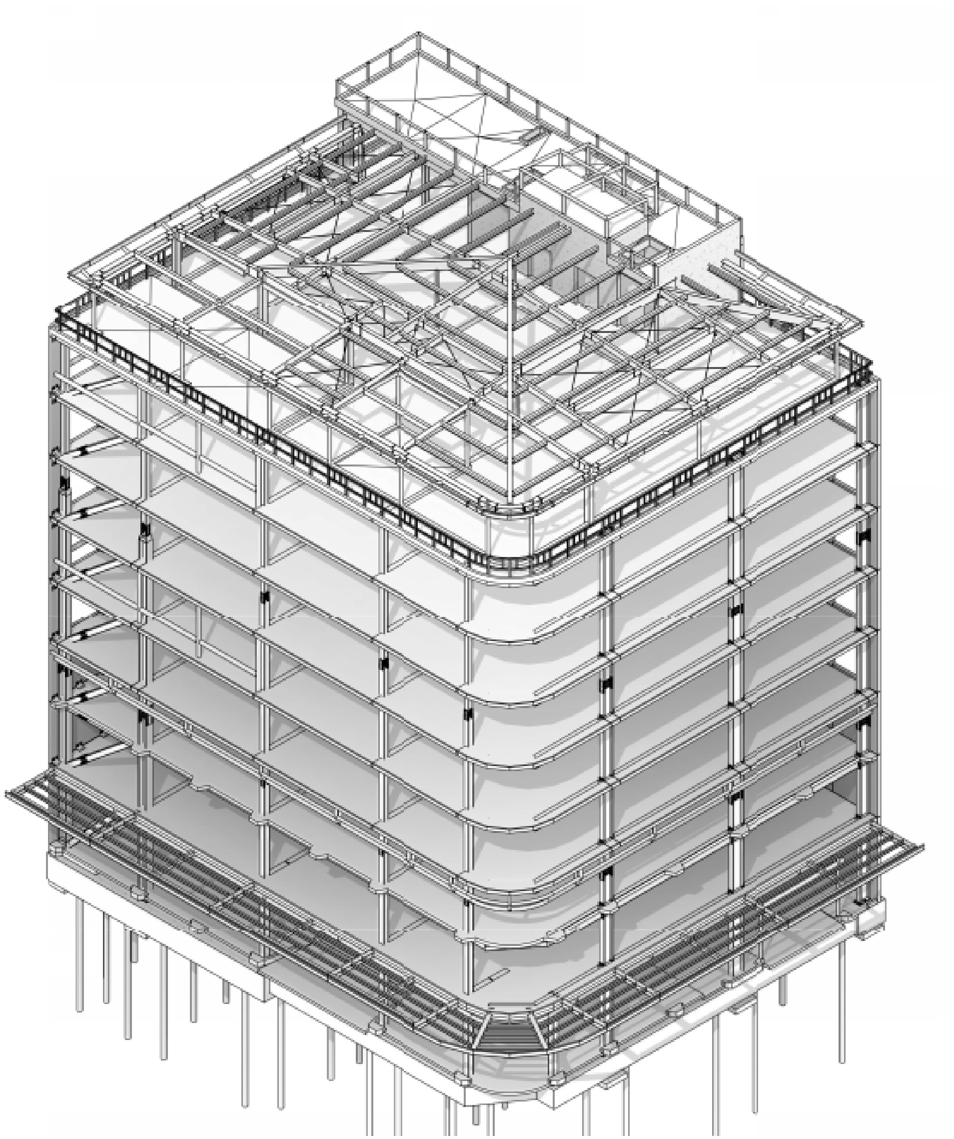
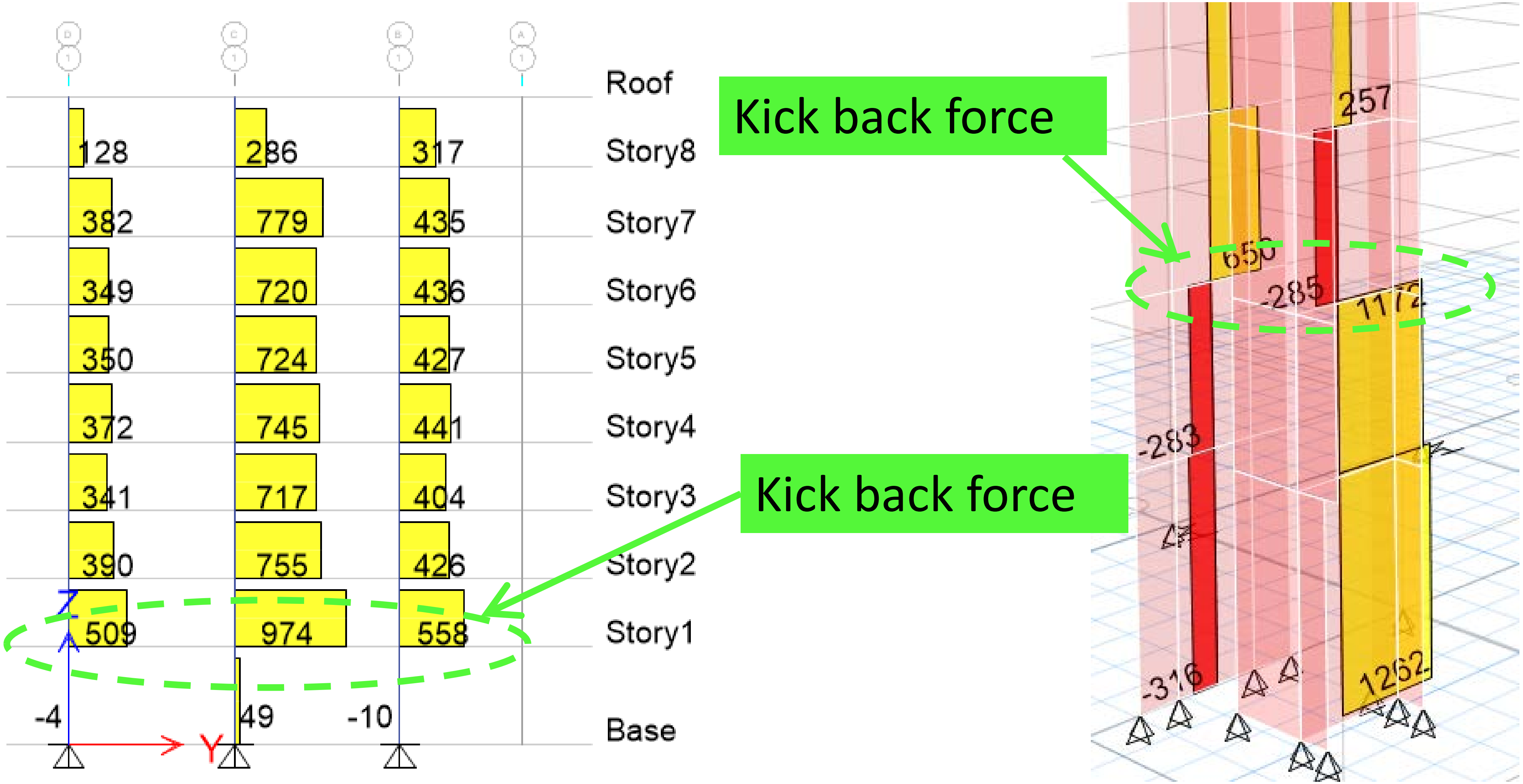




Topic 1: Interaction of Different Lateral Resisting Systems



Shear force in MRF Columns for EQ +Y

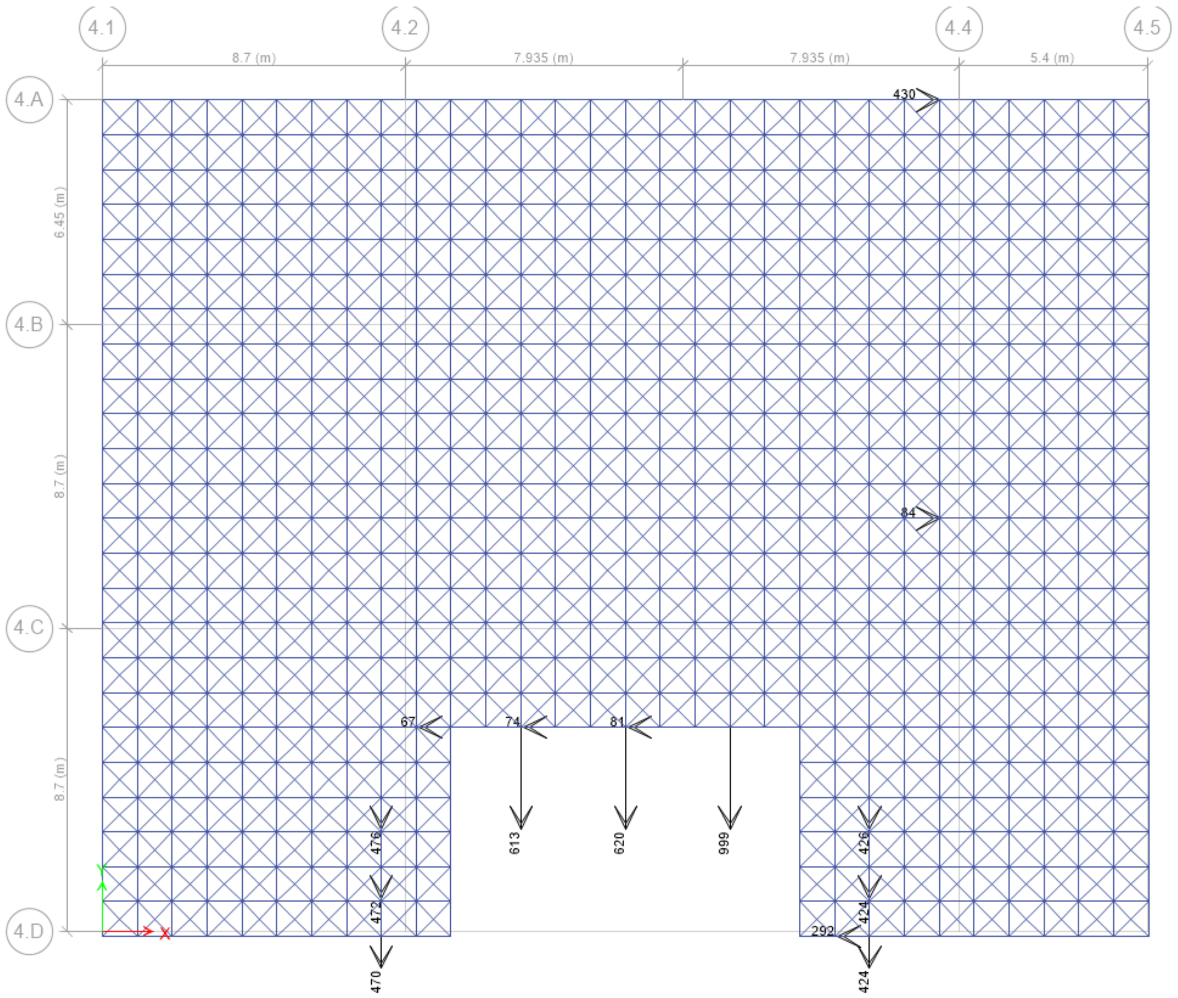
Shear force in Walls for EQ +X

Topic 1: Interaction of Different Lateral Resisting Systems

Common approaches to solve this issue:

1. If the load transfer is small,

then diaphragm is designed to carry the load.



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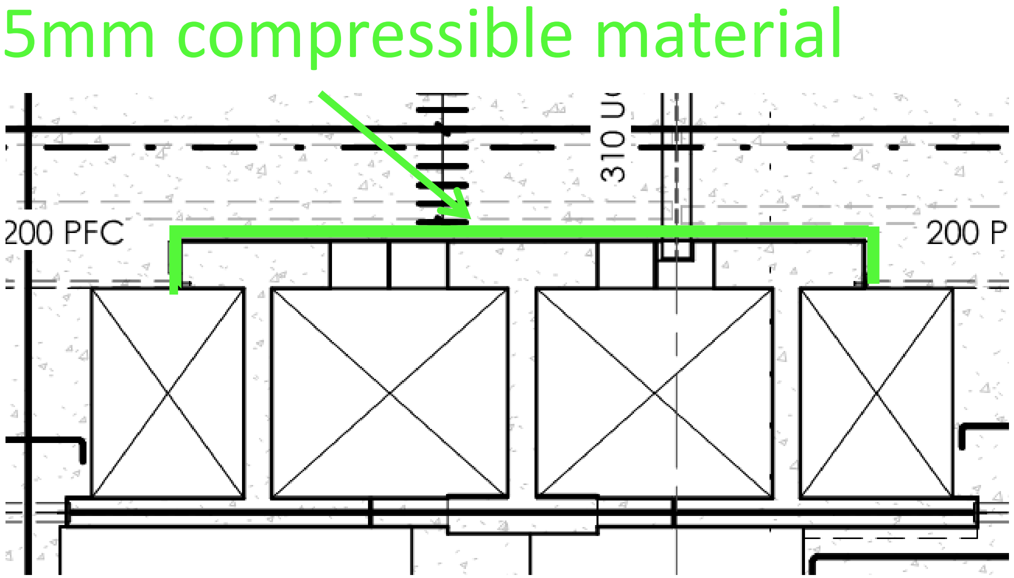
2. If there is a high load transfer,
then seismic separation of elements from diaphragm could be a solution.

Issue: We don’t use the full capacity of existing structural elements.



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There might be a 3rd approach:

Is it possible that the main portion of kick back force disappears after few first cycles of seismic shaking when concrete cracks formed in the floor?

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Proposed Experimental Tests:

Applying Cyclic Loads to a 2-3 Storey Building with Long, Short Concrete Walls, Steel MRF.

TOPIC 2: Seismic Performance of Nominally Ductile Steel Structures (μ=1.25) When Seismic Load is More than Design Load

Topic 2: Seismic Performance of Case no. 4 of NZS3404 When Seismic Load > Design Load

Table 12.2.6 – Relationship between structure category and member category
(Except as specified in limits on application (a) to (c) above and Notes 5,6)

Case number	**Structural ductility category**	**Capacity design to prevent soft storey mechanism undertaken**	**Type of member of structural system** (see Note 1)	**Minimum member ductility category**
1	1	Yes	Primary Secondary	1 2 (3) (see Note 2)
2	2	Yes	Primary Secondary	2 2 (3) (see Note 2)
3	3	Yes	Primary Secondary	3 3
4	3 μ=1.25	No	Columns All other members	2 (see Notes 1, 3) 3
5	4	No	Columns All other members	3 (see Note 4) 4 (see Note 4)

Topic 2: Seismic Performance of Case no. 4 of NZS3404 When Seismic Load > Design Load

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Concerns:

- There is always uncertainty about seismic loads.
- Capacity design can be ignored for design of Case no.4.

Topic 2: Seismic Performance of Case no. 4 of NZS3404 When Seismic Load > Design Load

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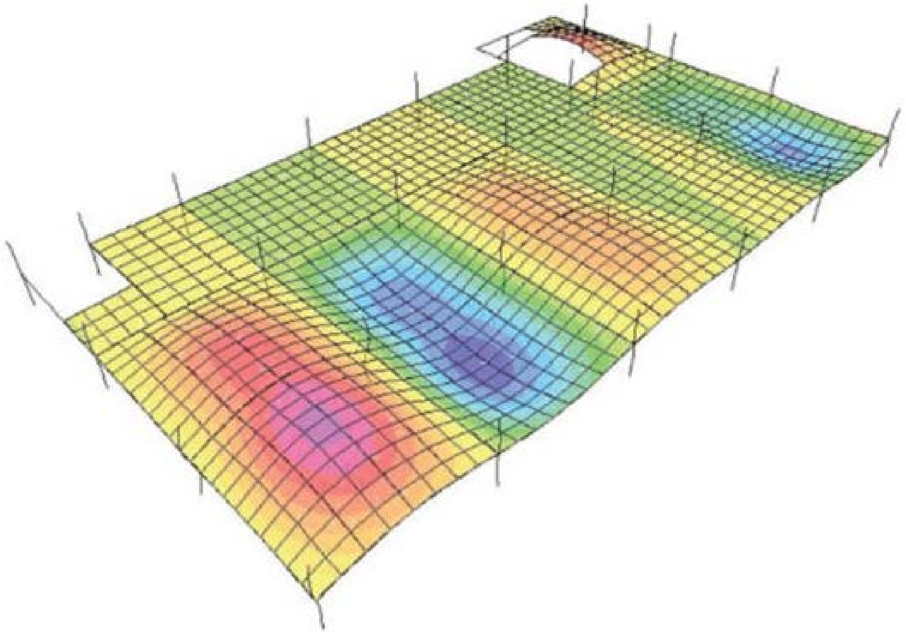
Suggested Experimental Tests:

A large scale experimental test might be conducted to investigate seismic performance of this category of steel structure when seismic load is more than design lateral load.

Is life safety still preserved?

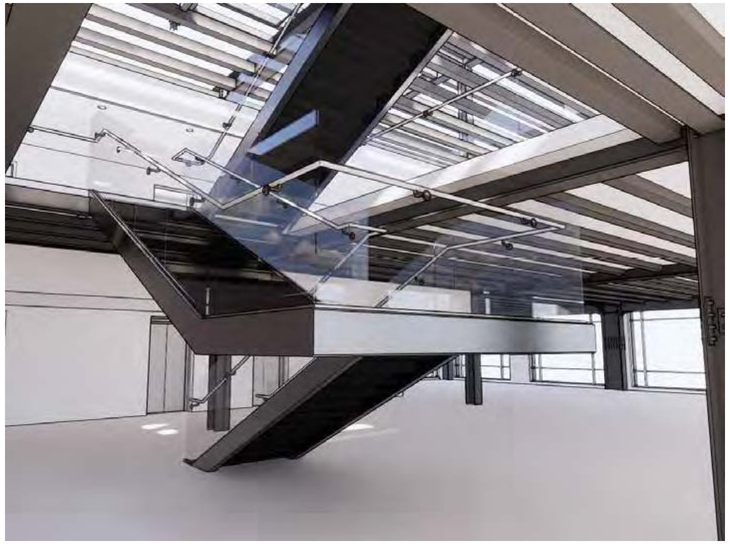
TOPIC 3: FLOOR VIBRATION



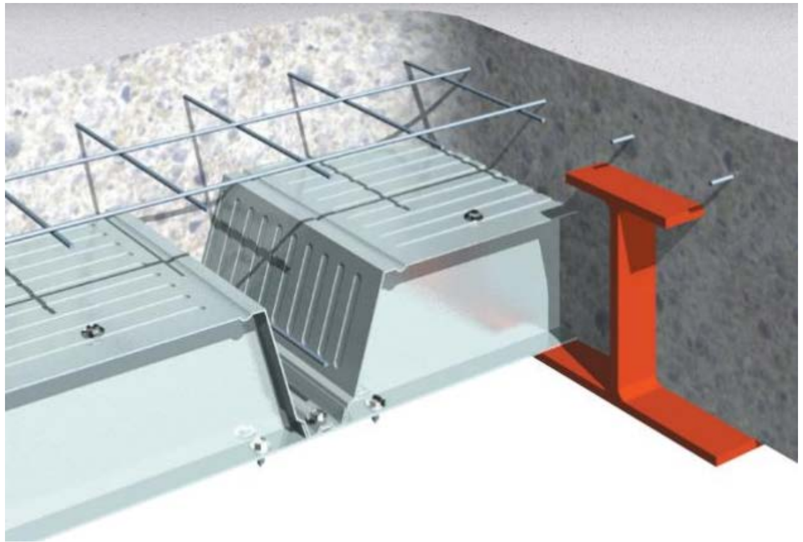
Topic 3: FLOOR VIBRATION

- Why Floor Vibration Is Becoming a Challenge ?

Open office Layout



Floating Stairs

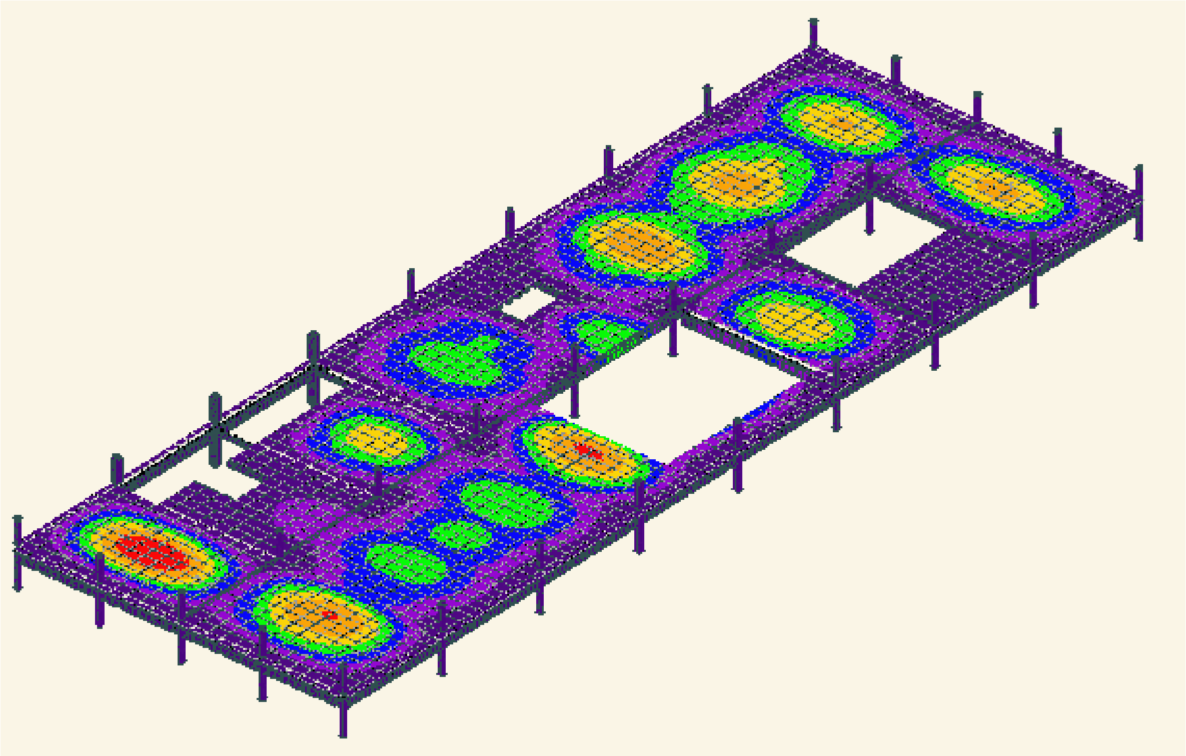


New Floor Products that can support long spans

Topic 3: FLOOR VIBRATION

Current Methods of Floor Vibration Design:

A. Finite Element Models



Issues:

- Complex modelling

- Very sensitive to modelling assumptions such as cracks in concrete floor, restrains from partitions, etc.

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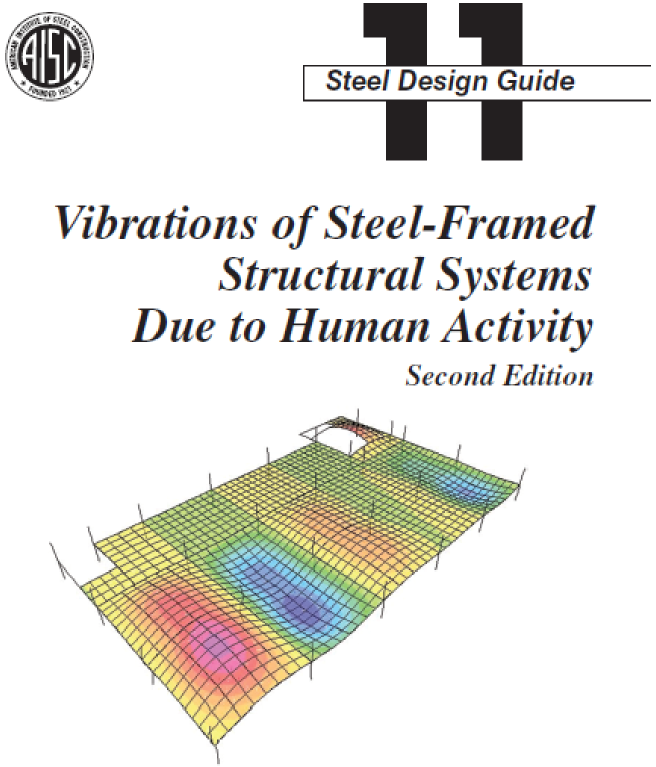
Current Methods of Floor Vibration Design:

B. Hand Calculations per AISC 11:



Issues:

- This method "**ONLY**" gives an **overall** estimation of the floor liveliness.
- Effects of partitions are neglected.

Topic 3: FLOOR VIBRATION

Research for Floor Vibration is necessary to be done in New Zealand since followings might be different from other parts of the world:

- Partition types and top connection to floor.

- Sensitivity of people to floor vibration might be different. For example, people in Christchurch are more sensitive to floor vibration because of Canterbury Earthquakes (2010-2011).

Topic 3: FLOOR VIBRATION

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Proposed Research Steps:

1. Nominate some existing building's floors

2. Experimental test on full scale floor. People walk with different frequencies. Accelerometers can record the vibration on the entire floor.

3. Finite Element Modelling of the floors and comparing the floor response with accelerations from Step 2.

Topic 3: FLOOR VIBRATION

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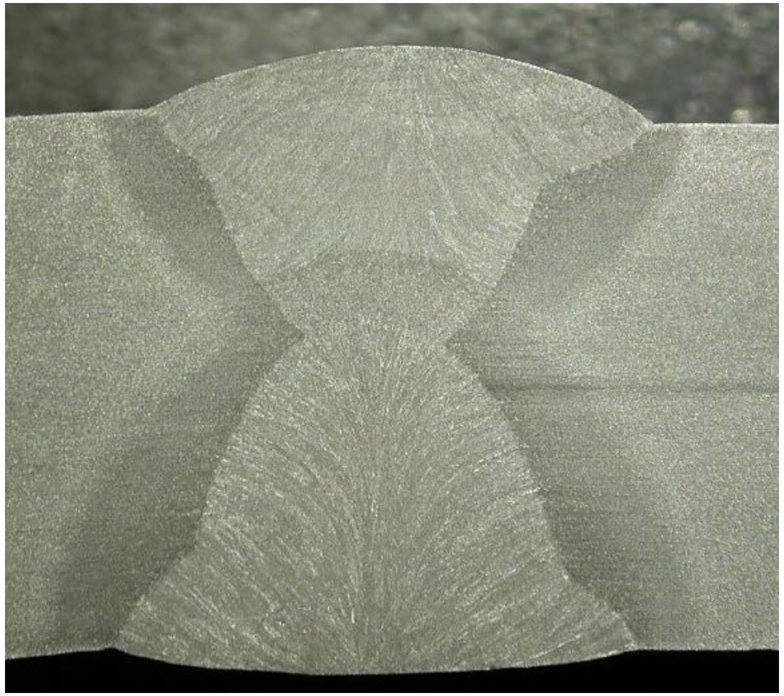
OUTCOMES:

- Recommendations for modelling, analysis and design based on typical floors, partitions, etc. in New Zealand.

- More detailed hand calculation method could be developed.

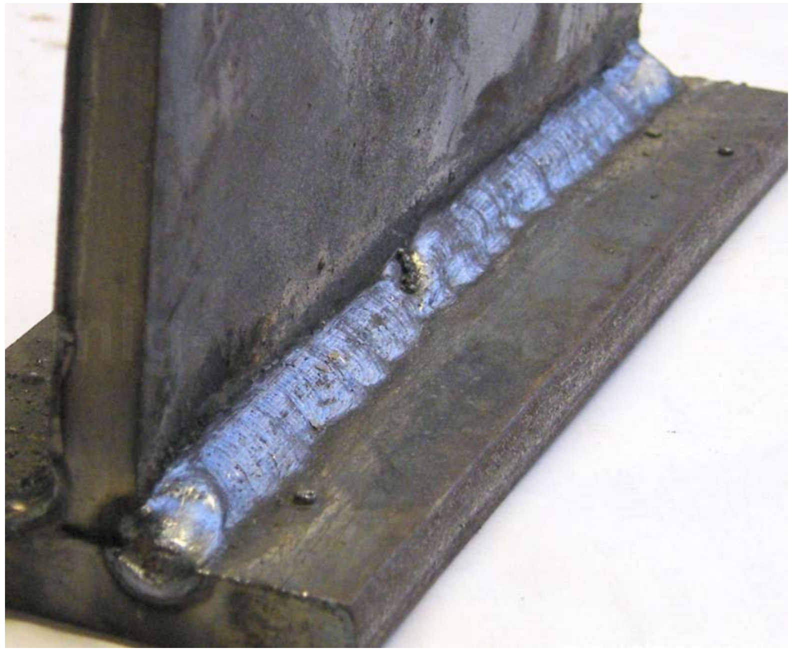
- This research could be a base for future "*New Zealand Floor Vibration Guideline*".

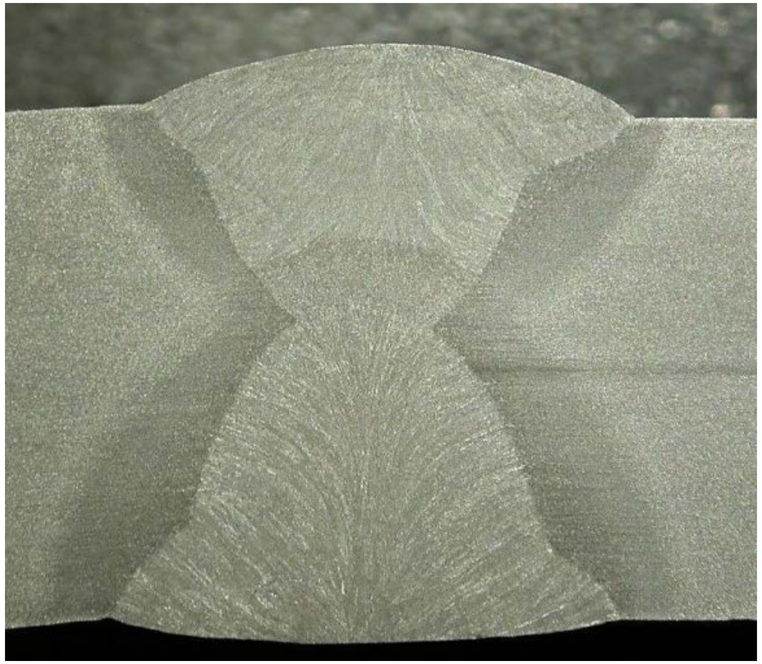
TOPIC 4: Developing Steel Details with Fillet Welding Instead of Full Penetration Butt Welding



Topic 4: FW Instead of FPBW

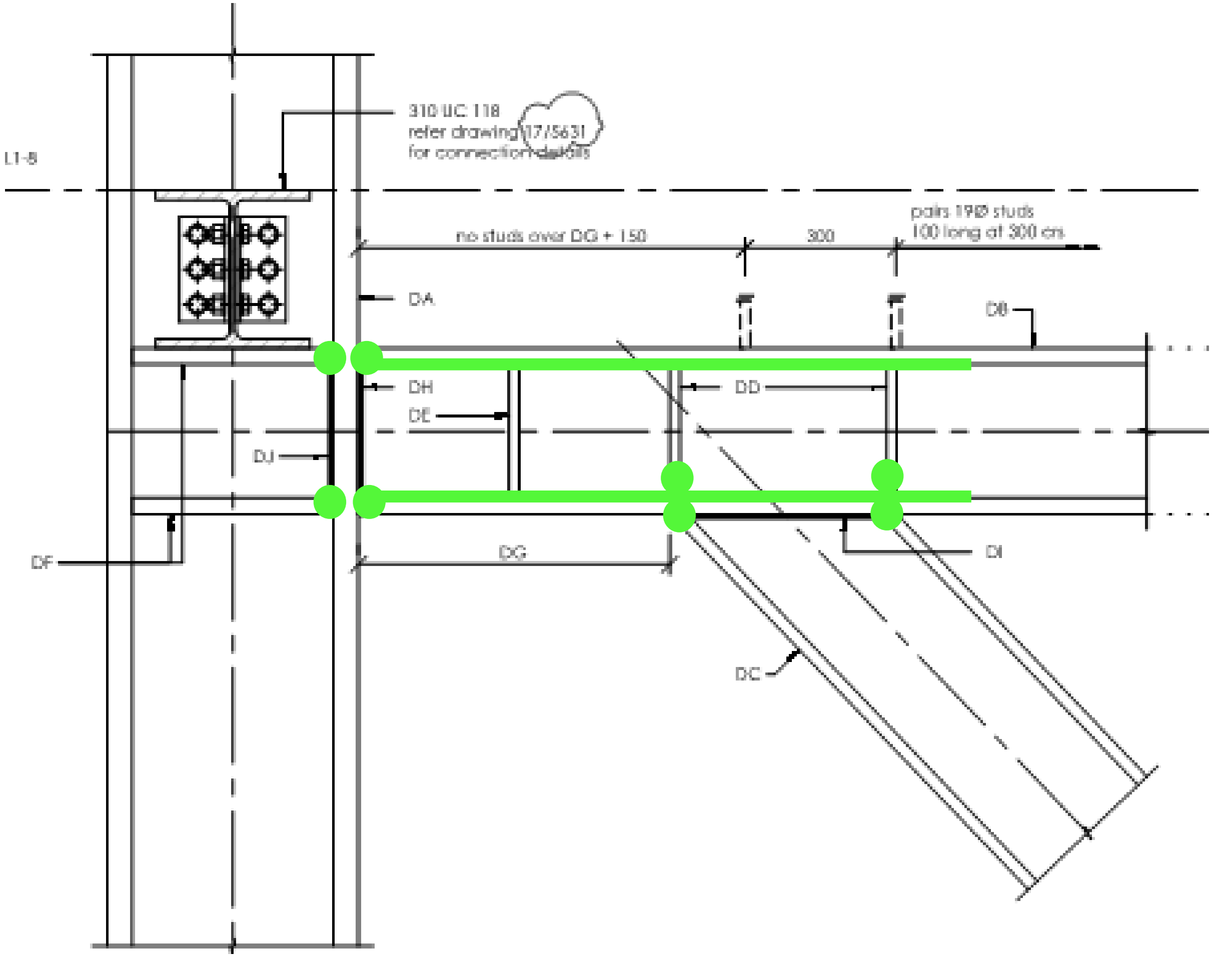
- ϕV 8 fw < ϕV 10 fw < ϕV 20mm FPBW
- 100 NZD/m < 190 NZD/m < 320 NZD/m+ welding inspection (450 NZD per report)



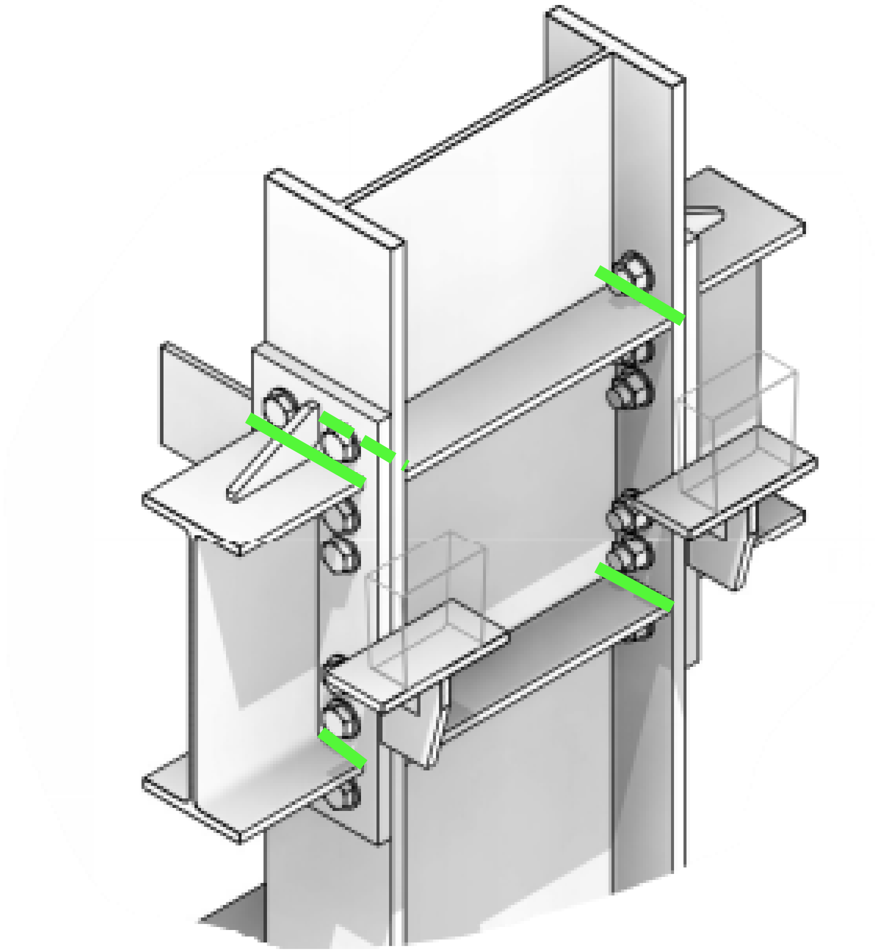


Topic 4: FW Instead of FPBW

A. EBF Frame



B. Steel MRF



Topic 4: FW Instead of FPBW

Research Question for Topic 4:

- Can FPBW in MRF and EBF be replaced with FW?

Answer to this question could lead to big savings in time and cost of steel fabrication.

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Thank you!

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UC University of Canterbury · The University of Auckland · Resilient Organisations · GNS Science · Massey University · Victoria University of Wellington · The University of Waikato · BRANZ

Topic 6:

Actual results (not theoretical modelling) of heat obtained from hydration modelling and temperature effects in large and deep concrete pours.

- Industry is typically bounded by supplier modelling and not always economical/feasible to do project specific trials.

- Current approach prevents thick layer concrete pouring in one stage.

Topic 5:

Extending research on Hollow Core floor systems to understand performance of other commonly used pre-cast floor systems. Particularly, precast ribs on bottom flange of steel beams, double T's on steel beams etc.